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# BUILDING FLOODLIGHTING

*And Its Possibilities With*

## TERRA COTTA



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NATIONAL TERRA COTTA SOCIETY  
19 WEST 44TH STREET  
NEW YORK





*Pacific Telegraph & Telephone Company Building, San Francisco, Cal.*

MILLER, PFLUEGER & CANTIN, ASSOCIATE ARCHITECTS

Entirely in Terra Cotta from sidewalk to roof the appearance of this building at night under illumination is magnificent and inspiring. It strikingly exemplifies the beauty and distinction which night illumination gives to the building of monumental design.



## ACKNOWLEDGEMENT

THE NATIONAL TERRA COTTA SOCIETY gratefully acknowledges its debt to Mr. W. D'Arcy Ryan, Director of the Illuminating Engineering Laboratory of the General Electric Company, for his inestimable service to the Terra Cotta industry in conducting the research which has demonstrated the facts set forth in this pamphlet.

No more valuable contribution has been made to the possibilities of American architecture than the discovery of those factors in the action of light upon materials which give them their fullest measure of beauty, both in daylight and under artificial illumination. To Mr. Ryan belongs not only this distinction but that of being quick to appreciate splendid possibilities in Terra Cotta offered by no other material and with the National Terra Cotta Society, to initiate their scientific analysis and demonstration.

This research, conducted at the General Electric Company's laboratory in Schenectady, has equipped all manufacturers in this Society to furnish material of the highest light reflecting efficiency. Not the least satisfaction has been the discovery that illumination costs can be greatly reduced, thus placing magnificent night lighting effects within easy reach of the average property holder.

The far reaching importance of this not only to building owners, but to communities and municipal authorities concerned with problems of street lighting, will be appreciated from perusal of the following pages. These reprint in part, by permission, the text of papers presented at the Twenty-Ninth General Meeting of the National Terra Cotta Society by members of the Illuminating Engineering Laboratory Staff, General Electric Company.

NATIONAL TERRA COTTA SOCIETY

19 WEST 44TH STREET

NEW YORK, N. Y.

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*Pacific Gas & Electric Company Building, San Francisco, Cal.*

BAKEWELL & BROWN, ARCHITECTS

Another distinguished example of California architecture whose beauty is perpetuated through the night hours by effective illumination. In this case also the exterior is entirely Terra Cotta.



## INTRODUCTION\*

By FRANK BENFORD, *Physicist, Illuminating Engineering Laboratory,  
General Electric Company*

THE rapidly increasing use of terra cotta for buildings of the better class makes the subject of the reflection of light by this material of peculiar interest to the illuminating engineer. A large number of recent buildings are of sufficient civic importance or architectural standing to warrant their being floodlighted so as to stand out against the night sky. America has developed a distinctive and imposing type of city architecture that is particularly adapted to American needs, and it is no easy burden that is laid on the illuminating engineer when he is asked to cooperate in maintaining the beauty of a facade throughout the night, and perhaps to add a touch of fairyland magic that the light of day seldom gives.

Even in the present transient condition of architecture, while the step back building is in its first stages of development, and floodlighting is the exception rather than the rule, the night appearance of our larger cities has been transformed. For the time being we are inclined to be content with a floodlighting installation that covers the facades at all points, and the details of the engineering do not painfully thrust themselves upon us. This happy condition is largely a touch of that pleasing ignorance that leads to bliss, but this also is transient. As the architect and engineer develop skill in the application of materials and light to this problem there will grow up a technique and a critical point of view that will not let us be content with certain conditions that are now acceptable on account of their novelty. Therefore, there need be no apologies made for here going into some of the simpler fundamentals of floodlighting as applied to terra cotta facades. These fundamentals are well established facts in other arts, and they, along with a vast array of derived data, will soon be the engineering foundation upon which will nightly rise glowing forms of beauty that will charm and delight beyond the "castles in Spain" of our childhood fancy.

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\* *From an address delivered to the National Terra Cotta Society at its semi-annual convention in Schenectady, June 3, 1927.*





*Brooklyn Edison Company Building, Brooklyn, N. Y.*

MCKENZIE, VOORHEES AND GMELIN, ARCHITECTS.

The illumination brings out the beauty of the upper stories and their architectural features in Terra Cotta, giving a striking effect against the night sky.



# Building Floodlighting and Its Possibilities

## With Terra Cotta<sup>\*</sup>

By H. E. MAHAN, *Application Engineer, Illuminating Engineering Laboratory, General Electric Co.*

NIGHT architecture is the term architects are applying to floodlighted buildings. This night architecture is not something that just happens after flooding a building with artificial light but is a distinct branch of architecture, true in the early stages of evolution, but offering possibilities beyond the imagination of most of us. That it is a distinct branch of architecture is obvious when we consider that architectural forms result largely from light and shadow and as the direction of daylight is quite different from the direction that it is usually feasible to deliver artificial light from, it is necessary for the architect to create his design with this thought in mind.

The architect designing a structure for its night effect has one other property of artificial light with which to let his fancies play. This is the quality or color of the light. Daylight, of course, varies in its spectral composition from sunrise to sunset but it is beyond our power to control it and its range of colors is very limited as compared to artificial light. It is, therefore, within the power of the architect to have his materials appear under artificial light in the same colors as under daylight and on the other hand, he may employ colors in

his artificial light to give an entirely different appearance to his building at night. It is in this latter use of light that his greatest possibilities lie, limited only by his own imagination and creative powers.

There is no material used in building construction that offers better facility to the architect in creating this night architecture than does terra cotta. This material has no limitations as regards form and color. The architect's imagination has free reign. Mr. Ryan has demonstrated with samples of your product the importance of quality and direction of light and Mr. Benford has told you how much of the light is absorbed and how much of it is reflected. The brightness of a floodlighted building to the observer is a function of the amount of light reflected from its surfaces toward his eye. It is reflected light, therefore, in which the engineer is interested in calculating the brightness of building surfaces. From this it would appear that absorbed light is wasted light and to a large extent this is true but it is necessary to derive our colors by this absorption method. The light from the mazda lamp contains all of the colors found in the spectrum. If we are to obtain the appearance of red, for example, we must absorb the other colors in one of

<sup>\*</sup> From an address delivered to the National Terra Cotta Society at its semi-annual convention in Schenectady, June 3, 1927.



two ways; either we must absorb them at the light source itself by means of colored glass, gelatine, etc., or we must absorb them at the reflecting surface by coloring the facing material of the building.

The choice between these two methods depends upon circumstances and the effects desired. Obviously, the method whereby the unmodified light of the mazda lamp is delivered to the building surface and the colors obtained by colored surfaces is the most flexible and economical in that the same quality of light may be used throughout. If we obtain our color effects by means of colored light much greater care must be exercised in the distribution of the light and the additional equipment usually involves greater initial expense. In many instances a combination of these two methods is desirable. It is obvious that terra cotta permits of as wide a range of variation from the standpoint of color as any other material used for building facings.

The strictly engineering features involved in the application of light to a building are few in number. We start with a knowledge of the amount of light required for the effect desired. This is a matter of judgment based on experience and scientific facts and depends upon such factors as:

- (1) Location of building with respect to conflicting illumination such as electric signs, street lights, etc.
- (2) Nature of surface of building with respect to its light reflecting properties.
- (3) Degree of contrast with the surroundings that is desired.
- (4) Special effects, such as color, high lights and shadows, etc.

We shall not enter into the methods of calculating the quantity of light necessary to provide the surface brightness desired. This can readily be done and the equipment necessary to provide the light determined. The next problem confronting us is to locate this equipment so as to give the direction and distribution of light required and here we again need the collaboration of the architect. It is very easy sometimes for the architect to make a slight change in his design that will make the difference between satisfactory and unsatisfactory accommodations for the lighting equipment, between concealed and visible equipment. It is also obvious that the wiring for our lighting system can be more economically and satisfactorily installed if provided for in the original plans and installed as the building is constructed than if installed as an afterthought. Such forethought will result in most cases in a saving of at least 50% in the wiring costs as well as better and more permanent workmanship. Mr. Raymond M. Hood, architect, says:

"The possibilities of night illumination have barely been touched. Up to the present we have contented ourselves with direct and floodlighting of varying intensity. There is still to be studied the whole realm of color, pattern and movement.

"Eventually the night lighting of buildings will be studied exactly as stage lighting is studied. Every means to obtain an effect will be tried, color, varying light-sources, direction, pattern and movement. In this last case, I cannot see any logical reason why a building should not be made to move and flutter."





*American Insurance Union Citadel, Columbus, Ohio*

C. HOWARD CRANE, ARCHITECT

This building, but recently completed and not yet subjected to floodlight illumination, is entirely faced with Terra Cotta, the finish of which has been found to have high reflecting power. This is indicated by the effect of ordinary street lighting upon the lower stories, as shown in the view above.



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*Book Tower, Detroit, Michigan.*

LOUIS KAMPER, ARCHITECT.

The upper stories of this building which are Terra Cotta are illuminated with crimson and yellow light, forming a symphony in coloring which is unique, distinctive and eloquent of the beauty which may be achieved in terms of color.



# Relation of Building Facades to Street Lighting\*

## Why Terra Cotta Means Brighter Streets

By A. F. DICKERSON, *Engineer*, Illuminating  
Engineering Laboratory, General Electric Company

IN THE daylight we never think of a business street as a strip of pavement. Building facades, show windows, automobiles and people form prominent parts of the business streets and should be as easily seen by night as by day. When light is confined to the pavement a street assumes a dismal tunnel appearance, so that to-day our problem is to effectively light the vertical sides of our business streets and when this is done we know that there will be plenty of light elsewhere.

In order that you may clearly understand why the light terra cotta faced building is an aid to street lighting, there are certain fundamental principles of optics that should be explained.

*First.* We see by reflected light. If an object doesn't reflect light we do not see it, although we may get an impression of its form or outline if it is silhouetted against a bright background.

*Second.* The amount of light reflected by an object in the direction of the eye is not a measure of its visibility. In other words, photometers do not measure visibility. Our vision does depend on the brightness of the retinal image and this brightness is in proportion to the amount of light that enters the pupil of the eye. The pupil is the cen-

tral opening in the iris. The incoming light through the pupil is focused in the forms of the objects in view by the crystalline lens on the retina or sensitive membrane on the back of the eyeball. The retina is connected to the brain by the optic nerve. The stimulation of the retina results in the visual sensation. The normal pupillary opening can contract to 1/64 of its greatest dilation; so it is quite apparent that the visibility of an object will be greatly lessened by anything that tends to close this opening.

*Third.* Glare tends to contract the pupillary opening. Blinding glare is largely due to contrast; i.e., the difference in brightness between an object and its background.

There are several causes for glare in street lighting but the one about which you are concerned is the darkness of backgrounds. As backgrounds or building facades become lighter the contrast between the luminaries and the backgrounds will diminish, glare lessens, the pupil becomes larger, more light enters, the retinal image becomes brighter and our vision improves.

From the above and from what has been told you regarding the reflecting qualities of light colored terra cotta, it is evident that with the proper surface for re-directing the light toward the eye, it becomes a

\* From an address delivered to the National Terra Cotta Society at its semi-annual convention in Schenectady, June 3, 1927.



distinct aid in brightening our streets at night.

On many streets where light colored buildings predominate, we are able to take into consideration these desirable characteristics and make a considerable saving in the amount of light necessary to produce a given effect. Unfortunately, buildings with light facades are usually in the minority on our older business streets so that we design the lighting for the dark buildings. In these cases the light colored buildings become distinctive on account of their brightness as contrasted with their neighbors.

Street lighting is usually classified in lumens per linear foot of street. The lumen is the unit quantity of light. It is the amount of light necessary to illuminate one square foot to the intensity of one foot-candle. The street in front of the Van Curler Hotel which you have probably seen at night has approximately 500 lumens per foot. When a street has over 300 lumens it is classified as an intensive White Way. To-day there are over fifty streets in this country so illuminated. The annual cost for lighting these streets will vary from \$10,000 to over \$50,000 per mile. If all these streets were faced with light terra cotta the same night effect could be obtained at a tremendous saving in light or a

greatly enhanced effect would be secured with the same lighting.

State Street, Chicago, with 2,000 lumens per foot is our brightest street but on account of its dark buildings and smoky atmosphere, it doesn't look much brighter than some of the terra cotta faced sections of Broadway, Los Angeles, with approximately only one-fourth the lumens per foot. The property owners of State Street are paying over ten dollars per front foot of property each year on a ten year contract, which should give you some idea of the cost of this high intensity lighting. In Detroit we have designed lighting for two streets that will appear to equal the Chicago system but will probably not cost two-thirds as much. This saving is effected mainly on account of the preponderance of light colored buildings on these streets.

White Way lighting pays dividends in enhanced property values and greatly increased sales. Night window shoppers will seek the brightly lighted cheerful street. We can, therefore, expect higher intensities each year and a spreading of the intensive lighting to most of the business streets of this country. Terra cotta has and will continue to play a prominent part in assisting us to bring brightness to these streets at the minimum expense.



## POSTSCRIPT

THE foregoing papers accompanied the presentation of technical reports covering the tests made with Terra Cotta at the Illuminating Laboratory of the General Electric Company during the past year. The data so obtained has equipped manufacturers in this Society to furnish samples of the finishes and colorings which may be most appropriate to any desired scheme of illumination.

Architects and owners interested to apply these developments in any projected buildings are referred to any of the manufacturers whose names will be found upon page 15, for conference in regard to specific applications, preferably before specifications are drawn.

Inasmuch as the effective illumination of any building is a highly specialized scientific art competent illuminating experts should also be consulted prior to determining requirements in material for the best results under the conditions of design. Joint conference with manufacturers and lighting experts is therefore recommended before selecting the particular type of Terra Cotta surface to be employed.

In general, rough textures of a certain type have been found more efficient in light reflecting power, conducing to the use of considerably less current than required for the smoother varieties. Contrary to what may be supposed the preservation of light-reflecting efficiency in these textures is not conditioned on frequent cleaning nor does their character develop this necessity otherwise. Research with various kinds of glass used for street lighting has established that with a glazed surface certain textures have a self-cleaning tendency, and that Terra Cotta glazes react similarly when correspondingly textured. Unlike the result in an absorbent surface dirt deposit is entirely superficial, does not affect the facets reflecting light rays, and flushes out readily when necessary to remove.



# TERRA COTTA

## *What It Is and Some of Its Merits*



TERRA COTTA is a burnt clay product which has been employed by mankind in building operations for more than forty centuries. It was an early outgrowth of the primitive brick making art in those countries bordering the Mediterranean which were the cradles of modern civilization. It is used generally for exterior finish and for permanent interior decoration.

Unlike brick, however, the pieces are not standard size units, but are made in special shapes and sizes according to architects' designs. They are made hollow in the back, enabling them to be bonded in with brick or other backing when conditions require a solid masonry wall. Being made of clay they can also be given a wide variety of form, shape and ornament without laborious carving, chiseling, etc.

Terra Cotta is made from molds, cast from previously prepared models and repetition of units from the molds distributes the original modeling cost fractionally to each piece. This eliminates the heavy cost of hand carved ornament in the finished work, assuring that any building may be given a beautiful decorative treatment at a readily possible expense. The use of burnt clay in building has also been recognized from time immemorial as affording the best protection against fire risks and as Terra Cotta in its manufacture has to pass through a higher heat than commonly encountered in the average conflagration its outstanding merit in this respect is obvious.

Impervious surface finishes and glazes, in all colors, have been brought to a high state of perfection in modern Terra Cotta and add greatly to the beauty and variety of effect obtainable. They do not absorb dirt, which remains only as a superficial deposit. Terra Cotta buildings can therefore be cleaned easily and inexpensively by a simple process of washing.



## Members

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(National Terra Cotta Society is a bureau of service and information operated by manufacturers of Terra Cotta in the United States for the technical and artistic improvement of product, the dissemination of authentic information relating to it and the assistance of the architectural and engineering professions in the proper and effective employment of this material.)



